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**ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES:
A SIGNALING PERSPECTIVE ON EMPLOYEE MOBILITY**

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ABSTRACT

Strategy and entrepreneurship scholars have identified many benefits of signaling for new ventures to access resources in financial and other factor markets. However, scholars have not studied the extent to which new ventures can employ signals to hire new talent. This paper investigates inventor mobility across biopharmaceutical new ventures and examines the effects of two signals, VC prominence and alliance network prominence. We suggest that VC prominence and alliance network prominence can provide assurances to prospective employees about a venture's resources and prospects, thereby facilitating inventor mobility owing to enhanced labor market efficiency. Empirical evidence from biopharmaceutical startups shows that new ventures can benefit from signals emanating from their ties to VCs and alliance partners and attract inventors to join them. We also find that these signaling effects attenuate as information asymmetry diminishes.

Keywords: mobility, signaling, VC prominence, alliance network prominence

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ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

INTRODUCTION

Recently, scholars have studied what types of employees work for new ventures (Dahl & Klepper, 2015; Ouimet & Zarutskie, 2014). Large firms attract employees with generous compensation packages, job stability, and better career opportunities. Individual employees may be hesitant to join ventures in early stages because these new ventures have higher probabilities of failure compared to established firms. The greater risk of failure, known as the liability of newness (Freeman, Carroll, & Hannan, 1983; Stinchcombe, 1965), inhibits new ventures from obtaining critical resources, including new employees. Although some ventures may have better chances of surviving, information asymmetry about a venture's technological capabilities makes it challenging for the venture to obtain important resources in factor markets (Acs, Morck, Shaver, & Yeung, 1997; Amit et al., 1990; Hsu, 2004). Access to human capital, in particular, can be especially important in industries where knowledge combination is the basis for competition. For new ventures competing in these industries, hiring new talent, such as scientists, engineers, or more broadly, inventors, can be an essential tool to obtain knowledge and renew the ventures' technological capabilities (Jain, 2016; Tzabbar, 2009).

Scholars, however, have yet to answer the question of how precisely ventures may attract new employees and address these market frictions. Strategy and entrepreneurship researchers have highlighted the role of signals in addressing the challenges posed by resource constraints. In the presence of information asymmetry, new ventures can engage in activities to signal their quality and facilitate economic exchanges in various factor markets (Connelly et al., 2011; Riley, 2001). Earlier research on information economics and signaling theory noted that new ventures could access superior resources. Thereby, ventures could overcome issues such as financing and access to partners (Gulati &

ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

Gargiulo, 1999; Hsu, 2004; Ozmel, Reuer, & Gulati, 2013; Stuart, Hoang, & Hybels, 1999). However, the literature has overlooked the relationship between signaling and access to human capital. We address this gap in the literature by examining how signals can help new ventures attract employees. Specifically, we focus on two important types of interorganizational relationships that can signal the venture's quality and its prospects: venture capitalist (VC) prominence (Gulati & Higgins, 2003; Lee, Lee, & Pennings, 2001) and alliance network prominence (Gulati & Gargiulo, 1999; Ozmel et al. 2013; Podolny, 2001). Evidence exists that the new venture's affiliation with prominent VCs and its network of alliance partners can convey that the new venture's unobservable resources and prospects are attractive.

Using a sample of new ventures from the biopharmaceutical industry, we investigate the effect of two signals on the hiring of new employees. We argue that new ventures can rely on the prominence of their VC affiliates and alliance network to signal their quality. These signals, in turn, suggest that ventures can offer superior resources and benefits to attract talent to join their firms. Studies on signaling and the labor market have shown that employees can use educational attainment as a signal of their productivity to appeal for positions and higher wages (Spence, 1974). In our study, we focus on reverse – how ventures use signals to be able to hire individuals. We find that affiliations with prominent VC firms and prominent alliance partners are positively related to the number of inventors that a new venture hires. Additionally, we study how these effects change when the new venture goes through several rounds of venture capital investments. We find that the effects of the signals weaken as the number of investment rounds a new venture goes through increases and the venture matures and accumulates a track record.

ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

By studying the impact of signaling on the ability of a new venture to hire individuals, we contribute to the literature on signaling and employee mobility. First, this paper contributes to the new venture literature by showing how new ventures can overcome the liability of newness in the labor market. We do so by investigating an underexplored link between firm signaling and the hiring of employees. Second, we contribute to the literature by showing that signals can have an impact on the labor market. Finally, our study examines the signaling effects over time and finds that these effects become less pronounced as the new venture goes through multiple investment rounds. Our arguments and evidence therefore have important implications for how early stage ventures in particular can attract human capital and overcome frictions in labor markets.

THEORY AND HYPOTHESES

Background Theory

New ventures face significant challenges in procuring the resources needed to develop their products (Freeman, et al., 1983). On the one hand, new ventures lack a proven operating history (Stuart et al., 1999). On the other hand, the ventures may not disclose private information that may be critical for the venture's valuation and growth because of misappropriation concerns (Arrow, 1962). Consequently, new ventures are incentivized to misrepresent information about their resources, products, and operations to obtain resources (Amit et al., 1990). The classical "lemon's problem" results, as other parties are unable to differentiate "good" and "bad" ventures (Akerlof, 1970). New ventures, thus, may become constrained in terms of access to critical resources. New ventures must learn to cope with information asymmetry and the adverse selection problem to address the

ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

challenge of access to resources. Ventures can deal with this situation by engaging in costly activities to signal the quality of their resources and market prospects.

The liability of newness, defined as the higher risk of failure of new firms, can be explained in part by the constraints new ventures face to obtain resources. In industries where the combination of knowledge is central to a firm's activities, access to human capital can be as important as access to financial resources. Through hiring events, new ventures can acquire knowledge and technical capabilities (Tzabbar, 2009). While a firm would be reluctant to hire an unproductive worker at high wages, the opposite is also true: Talented knowledge workers will have concerns about the viability and prospects of new ventures they are considering joining, and they may prefer those with more attractive prospects (Acs et al., 1997). In the case of new ventures, however, it is difficult for inventors working in other firms to assess the prospects of a new venture. New ventures may use signals to deal with this information asymmetry. Previous work from the signaling literature has studied the mobility of individuals from the perspective of job applicants. Spence (1974) shows that at the individual level more productive job applicants need to engage in costly activities, such as higher educational achievement, to gain a higher salary compared to less productive job applicants. While productivity is not directly observed, employers may infer quality and capability through the signal of a job applicant's educational attainment. Employers may assume less productive job applicants would find it costly to achieve a high level of education achievement (Spence, 2002). In this paper, we argue that signaling can help new ventures hire inventors as it can increase the likelihood that these inventors will join the venture whose unobserved resources and prospects inventors judge to be attractive via signals.

ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

In knowledge-based industries, new ventures need access to valuable human capital to develop their capabilities. Because human capital is one of the firm's main sources of knowledge (Coff & Kryscynski, 2011), recruiting inventors can be a useful tool to acquire external knowledge (Rosenkopf & Almeida, 2003; Song, Almeida, & Wu, 2003). One of the primary reasons new ventures may need to hire inventors, thus, is related to the exploitation of knowledge spillovers that can be channeled into the firm by new inventors. As a result, a better understanding of how new ventures can attract these inventors can help to explain why some ventures are able to survive. We argue that new ventures can deal with this challenge through signaling. Existing literature on signaling theory in the context of high-tech new ventures has extensively analyzed the impact of two important signals, namely VC prominence and alliance network prominence, on various factor markets such as financing, liquidity events, partner selection, and contract negotiations (e.g. Gulati & Higgins, 2003; Ozmel et al., 2013; Reuer, Tong, & Wu, 2012; Stuart et al., 1999). We propose that these signals can also help new ventures hire inventors and overcome frictions in labor markets.

Venture Capital Prominence

New ventures can address the fact that prospective employees face information asymmetry regarding the future of the ventures through affiliating with prominent VC firms. New ventures backed by prominent VC firms can signal their quality for several reasons. First, VC firms need to conduct thorough due diligence on the ventures in which they invest because of the information asymmetry concerning the venture's resources, capabilities, and growth opportunities (Carter & Manaster, 1990). As a result, investments by VC firms can signal that a venture has valuable resources and attractive growth

ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

potential. Second, prominent VCs are highly selective, and conduct careful screening processes to choose a small number of investment targets to develop over time. Because prominent VCs have high visibility and excellent reputations as successful investors, they try to maintain their prestige by weeding out low-quality ventures prior to investing (Hsu, 2004; Podolny, 1993). Therefore, new ventures affiliated with these prominent VCs are seen as having better chances of surviving than other ventures. Finally, new ventures tend to bear high costs associated with obtaining affiliations with prominent VCs (Hsu, 2004), and high-quality ventures are more likely to be able to bear such costs than lower quality ventures. The new venture is in effect paying for a lease of the reputation of such VCs. We argue that for these reasons, inventors that are joining the labor market or that are working for other employers may view ventures backed by prominent VCs as valuable employers to prioritize. As new ventures receive the perceived endorsement by prominent VC firms, they gain a visibility boost in the labor market and can reach a broader set of potential employees. Additionally, new ventures can underscore their current affiliations with prominent VC firms during the employee selection process and thus attract the high-quality candidates. Therefore, our baseline prediction is that affiliations with prominent VC firms make it more likely that the new venture can hire inventors.

H1. A new venture's affiliation with prominent VCs will have a positive impact on the number of inventors joining the new venture.

Alliance Network Prominence

The affiliations a new venture maintains in the alliance network can similarly convey signals on the new venture's resources and prospects (Jensen, 2004). Thus, the alliance network can also have an impact on the number of inventors that a new venture can hire,

ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

for several reasons. First, alliance partners themselves face information asymmetry when making partnering decisions with new ventures. To alleviate problems associated with adverse selection, alliance partners also carry out due diligence and evaluations before alliance formation as well as during their process of engagement with a venture (Nicholson, Danzon, & McCullough, 2005). Thus, the fact that the new venture can form extensive ties in the alliance network serves as an indicator for the quality of its resources and prospects (Jensen, 2003; Ozmel et al., 2013). Second, alliances allow firms to combine knowledge that may not be connected otherwise, so partnerships convey that the firm has access to resources outside its boundaries and that its own resources are in demand by other organizations. Inventors, when looking for a job, may also consider the potential to combine their knowledge and the future prospects that alliance convey. One important reason inventors seek new employment is the extent to which they could exploit their current knowledge and explore new knowledge (Ganco, 2013; Zenger, 1994). Thus, inventors may positively assess the possibility of working for a new venture affiliated to prominent alliance partners. We expect that the new venture is more likely to hire additional inventors as alliance partners provide positive endorsements of the new venture and better prospects for knowledge combination in the future.

H2. A new venture's prominence in its alliance network will have a positive impact on the number of inventors joining the new venture.

The Contingent Effects of Signals

The two interfirm relationships discussed in the foregoing section—VC backing and alliances—can help individual inventors draw inferences about the quality of a new venture. The signaling effects would be weakened with any reduction in information

ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

asymmetry. As the new venture's financing rounds increase over time, uncertainty about the firm's prospects decreases, and the information asymmetry between the new venture and prospective employees is expected to diminish (Heeley, Matusik, & Jain, 2007). For instance, Stuart et al. (1999) finds that the relative weight given to a startup's early signals, as opposed to a startup's actual performance, should decrease with the age of the firm. This phenomenon is evident in more favorable deals that ventures receive when their founders have more demonstrable experience (Kaplan & Strömberg, 2004).

We therefore submit that the level of information asymmetry between the new venture and the labor market determines the strength of the previously hypothesized effects. As a new venture goes through multiple VC investments in successive rounds, the new venture gives out more information about the firm, thus reducing information asymmetry. As the number of investment rounds increases, we therefore expect signals will play a lesser role. There are three main reasons to explain why prospective employees will rely less on signals as the information asymmetry declines. First, prospective employees can interpret the new venture's number of investment rounds as evidence that the venture will survive in the medium term. Studies have shown new ventures' survival chances significantly increase after the first few years of operations (Acs et al., 1997). Therefore, prospective employees are more confident that ventures that have gone through multiple investment rounds are more likely to survive. Second, the new venture's number of investment rounds also determines the extent to which it will obtain higher quality resources or better deals. When new ventures demonstrate that they can secure multiple financing rounds, prospective employees infer the venture is more likely to secure high-quality resources in the future. Finally, a new venture that has gone through several rounds of funding more visible in the

ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

labor market. Inventors in other firms can learn about the new venture through mechanisms other than the venture's affiliations. Therefore, we expect that the positive effect of VC affiliation and alliances on the hiring of new inventors attenuates as the new venture's number of investment rounds increases.

H3. The positive effect of a new venture's VC prominence on the inventors joining the new venture will diminish as the new venture's number of investment rounds increases.

H4. The positive effect of a new venture's alliance network prominence on the inventors joining the new venture will diminish as the new venture's number of investment rounds increases

METHODS

Sample and Data

To test the hypotheses, we collected data from multiple sources. First, we gathered information from Thomson Reuters' VentureXpert on a sample of venture capital-backed startups in the biotechnology industry that received their first venture funding between 1980 and 2004. We then built the career histories of inventors employed by these firms. To identify the inventors that were employees of the firms in the sample, we matched the assignee names from the USPTO patent data to the names of the new ventures. After matching the patents to the ventures, we obtained the inventor data from the inventor name disambiguation project by Li et al. (2014). Using these data, we created a career table in which each inventor was associated with an employer each year. To isolate the effects of VC prominence and alliance formation, we performed the analyses using the years prior to a new venture's IPO or the acquisition of the new venture. Our final sample consists of

325 ventures in the bio-pharmaceutical industry, and combining we have 1657 venture-year observations from 1985-2008.

Dependent variable

We measured mobility as the number of inventors who have moved into the focal firm in a given year. Therefore, we define *Mobility* as the number of inventors who have joined the firm in a given year. Because changes in the name of an inventor's employer is a necessary, but not sufficient, condition for establishing mobility between two firms,¹ we manually checked if changes in an employer name were mobility events.

Independent variables

We measured *Venture Capitalist Prominence* via the eigenvector centrality of the VCs in the VC syndicate networks (e.g., Bonacich, 1987; Ozmel et al., 2013; Podolny, 1993). The centrality of VC firm i in year t is measured using all of the direct and indirect syndicate ties formed between VC firm i and all the other VC firms during the most recent past five years (between $t - 5$ and t), as shown below:

$$VC\ Prominence_{i,t} = \sum_{j=1}^{N_t} (\alpha_t + \delta_t c_{j,t}) R_{i,j,t} \quad (1)$$

where $c_{j,t}$ is the centrality of the VC firm j in year t ; $R_{i,j,t}$ is the relationship matrix entry indicating the number of co-investments between VC firm i and VC firm j during the last five years; δ_t is the weighting coefficient, which is set equal to three quarters of the reciprocal of the largest eigenvalue of R (e.g., Jensen, 2003; Podolny, 1993); and α is the

¹ As an illustration, in 2002 American Home Products Corporation (AHPC) changed its name to Wyeth. Thus, inventors employed by AHPC might appear as they moved if they are later employed by Wyeth, but in fact they kept being employees of the same firm.

ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

scaling factor, which assures that the maximum centrality for each year is equal to 1 across all the VCs. If there are multiple VCs investing in a technology venture, we picked the maximum of those VCs' centralities (Ozmel & Guler, 2015). We also investigated the mean value to assess the sensitivity of the findings. The results of these analyses are qualitatively similar.

Our second theoretical variable is *Alliance network prominence*. We measured the focal venture's alliance network prominence based on its eigenvector centrality in the alliance network (Bonacich, 1987; Ozmel et al., 2016), using data from Thompson Reuters Recap on alliances formed in the biotechnology industry:

$$Alliance\ Network\ Prominence_{i,t} = \sum_{j=1}^{N_t} (\alpha_t + \delta_t c_{j,t}) R_{i,j,t} \quad (2)$$

where $c_{j,t}$ is the centrality of the new venture i 's alliance partner, established company j , in year t , and $R_{i,j,t}$ is the relationship matrix that shows the number of alliances formed between i and j during the last five years, up to year t . We normalized the centrality measure so that the maximum centrality in a particular year is equal to 1. It is important to note that while the alliance network prominence variable is calculated looking at the new venture's ties, the VC prominence variable is calculated considering the VC firms' ties. The new venture is indirectly related to the VC syndication network but it is an actor of the alliance network. We argue that this difference is less of a concern in this setting because we are interested in the signaling effect of these affiliations.

To test the moderating hypotheses (H3 and H4), we calculated the variable *number of investment rounds* as the cumulative number of investment rounds in which the new venture had participated (Stuart et al., 1999).

ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

Control variables

CEO and top management team. The managers' characteristics can potentially determine future funding as well as hiring. Thus, we controlled for (1) the age of the CEO (*CEO Age*), because age captures a CEO's experience and (2) whether the CEO had prior experience in the focal industry (*CEO Industry Experience*), because it captures the extent to which the CEO may obtain access to important resources (e.g., Shane & Stuart, 2002). Finally, we controlled for the *Top Management Team (TMT) Size* because larger teams may be better equipped to manage firms in uncertain conditions (e.g., D'Aveni & Kesner, 1993). Data for these above variables were hand-collected from Mergent Online and Bloomberg Business in addition to VentureXpert.

Venture's characteristics. We also controlled for the venture's characteristics: (1) *Firm Age* helps to capture the extent to which a venture faces the liability of newness (Stinchcombe, 1965), (2) *Star Presence* is a dummy variable that captures whether the firm has existing high quality human capital (Tzabbar, 2009; Tzabbar and Kehoe, 2014; Kehoe and Tzabbar, 2015), (3) *Citation-Weighted Patent Stock* measures a venture's knowledge as the average number of forward citations that its patents received in subsequent years (Ahuja and Katila, 2001; Sampson, 2007; Kehoe and Tzabbar, 2015), and (4) the *Pipeline* of the new venture by measuring the number of products at preclinical, clinical, and commercialization stages.

VC firms' characteristics. We controlled for the *VC's Early Investment Stage* because it serves as a proxy for the ability of venture capital firms to manage investments in risky ventures. We measured this variable as a dummy that equals one when the venture is backed by a VC fund focusing on the early stage in VentureXpert's classification. In

ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

addition, our models also include year and industry subgroup fixed effects that help us to account for time trends and industry characteristics.

RESULTS

Tables 1a and 1b present descriptive statistics and a correlation matrix. We excluded observations where firms went through initial public offerings, acquisitions, or became living dead (i.e., firms that do not obtain additional VC funding for at least seven years due to low financial returns) (e.g. Mason & Harrison, 2002). The resulting sample consists of 1657 firm-year observations in our sample. At a given year, the maximum number of employees joining a new venture in our sample is 10, and the minimum is 0, meaning that no scientist is hired in that particular year. We also examined variance inflation factors (VIF) to diagnose potential multicollinearity concerns and find that the mean VIF is less than 3 for all models and the maximum is well below 10.

----- Take in Table 1 -----

In Table 2, we report the results of negative binomial models where the dependent variable is *Mobility*, which is the count of employees hired by a venture each year. We used negative binomial models for our regression because of the count nature of the dependent variable and over dispersion of the mobility events. The dispersion parameter and chi-squares are significant in all our models ($\chi^2 = 174$, $p < 0.01$), thus confirming over dispersion in the data and supporting the use of the negative binomial models rather than Poisson models. We report heteroscedasticity-robust standard errors clustered on the new ventures. Column (1) is the baseline model with just control variables. Column (2) shows the main effects of the theoretical variables capturing signals by new ventures, and columns

ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

(3)-(4) show interactions between each signal variable and the number of investment rounds. Finally, column (5) includes the full set of interactions.

----- Take in Table 2 -----

We begin with the results of the main effects model shown in column (2) of Table 2. In the main effects model, the coefficients of both alliance network prominence and VC prominence are significant at the $p < 0.01$ level of significance. The positive associations are in line with both Hypotheses 1 and 2 concerning the effects of signaling. In particular, the effect size for alliance network prominence is much higher than that of VC prominence. These results accord with the study's basic proposition that signals can ease adverse selection concerns of inventors, as these signals convey positive information on the firms' resources and prospects.

We next investigate the effect of VC prominence and alliance network prominence when the level of information asymmetry of the new venture diminishes as the number of investment rounds increases. Columns (3)-(4) show that the coefficients of the interaction terms of each signal variable and the number of investment rounds are negative. Specifically, the interaction coefficient of VC prominence and the number of rounds in column (3) is -0.232 ($p < 0.1$), and the interaction coefficient of alliance network prominence and the number of rounds in column (4) is -1.435 ($p < 0.05$). These associations moderately indicate a dampening effect of the new venture's track record on the signaling variables. Therefore, our Hypotheses 3 and 4 are supported. Column (5) shows the contingent effect of the signals when they are both investigated at once, and the findings are consistent with those presented in the separate models. The results and signs of the coefficients of our key independent variables are consistent across the models. These

findings potentially imply that both signals of alliance network prominence and VC prominence are associated with new talent hires.

To further investigate the interaction effects in nonlinear models such as ours (Greene, 2010), we created two simulation-based interaction figures and illustrate the results of the contingent effects of both signal variables in Figures 1 and 2. Specifically, Figure 1 indicates that the effect of VC prominence is positive yet diminishing till the seventh investment round, which is in line with the expectation that the VC-related effects tend to be more pronounced in the earlier stages of venture growth. Similarly, as shown in Figure 2, the effect of alliance network prominence is quite pronounced in the early stages till the sixth round, and then start to diminish. This may be interpreted as a longer-lasting signaling effect through the new venture's own network of alliance partners compared to that of its venture capitalists.

----- Take in Figures 1 & 2 -----

Supplementary Analyses

We conducted several additional analyses to examine the robustness of the results. First, we ran logit models predicting the likelihood of hiring one or more inventors in a year and zero-inflated negative binomial models. The results are qualitatively similar. Second, we addressed the potential concern that new ventures are hiring for growth purposes only. To rule out this alternative explanation, we examined whether the ventures hire high-quality inventors or not. Following prior research on high-quality and star scientists, we consider an inventor as high-quality based on two criteria: the number of granted patents and the number of forward citations their inventions have accumulated over the years (Groysberg, 2010; Kehoe and Tzabbar, 2015; Tzabbar and Kehoe, 2014; Zucker

and Darby, 2001). Consistent with our main hypotheses, we found that ventures hire high-quality inventors when they are affiliated with prominent VC firms and alliances partners. That is, the two signals are associated with hiring not just more inventors, but in fact inventors of much higher quality. We did not find that the signals were associated with the hiring of low-quality inventors.

Third, we examined the endogeneity of the two signaling variables. We use a two-stage model to control for the self-selection issues of our VC prominence variable. The first-stage model assesses VC-backing using state dummies for instrumentation purposes, and the resulting second-stage model shows that the self-selection term is insignificant (Baker & Gompers, 2003). Then, to rule out the possibility of employee-poaching directly from the new venture's alliance partners, we excluded all mobility events wherein an inventor leaves the alliance partner firm and join the new venture, and the results still hold.

DISCUSSION

Contributions and Implications

By exploring the effects of signals on inventor mobility into startups, our study makes several contributions to the literature. First, we propose and test an underexplored link between firm signaling and employee mobility. Because small and medium-sized ventures play an important role in the process of creative destruction, it is important to understand how new ventures can obtain knowledge and capabilities through the hiring of inventors (Acs et al., 1997). We respond to calls for research on the antecedents of employee mobility (Mawdsley & Somaya, 2016) by focusing on how new ventures can hire talent by overcoming frictions they otherwise experience in the labor market.

ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

Second, our study advances research on information economics and signaling theory by identifying signals new ventures potentially convey to the labor market. The previous economics literature on information economics has elucidated the effects of signaling by prospective recruits (Spence, 1974). Our study complements prior research by looking at how new ventures can engage in signaling to shape the attraction of human capital to the new venture. Management research has examined how firms use interfirm ties as signals to access resources in financial markets as well as partner selection (e.g. Riley, 2001; Connelly et al., 2011) but has overlooked the link between signaling and employee mobility for high tech ventures. We therefore argue and show how signals can play important roles in these factor markets, so firm's affiliations with VCs and alliance partners can have interesting spillover effects on the labor market in addition to financial markets and markets for technology.

Third, signaling theory research has also suggested that the benefits of interorganizational relationships are likely to depend on the informational environment of signals in different stages of the life of the firm (e.g. Gulati & Higgins, 2003). Our theory suggests that the signaling value of interorganizational ties in the labor market varies across the different stages of the new venture's funding rounds. We find that the benefits of such signals are greater when new ventures are at the earlier financing stages, and the signal value of the new venture's alliance network prominence is longer lasting compared to that of VC prominence in later rounds. We interpret this set of findings as the decaying of signaling effects as information accrues over time. As the new venture proceeds through successive funding rounds, matures, and develops a track record, signals take on less importance for attracting knowledge workers. Our study invites analysis of other signals

and contingencies that potentially shape the new venture's ability to access human capital and respond to frictions in markets for inventors.

Limitations and Future Research Directions

Our study's limitations also present several fruitful avenues for future research that extensions could explore. In this study, we focus on the hiring of knowledge workers at the firm-level. Future research may collect additional data to study the new venture's hiring tactics. While new ventures form interorganizational ties as signals to boost its visibility in the market, it would also be important to examine how new ventures communicate their strengths and career opportunities to job candidates. We encourage future studies to investigate specific tactics new ventures can use to attract certain inventors.

Another interesting topic is related to legal constraints that may inhibit certain individuals from moving to other firms. Prior studies have shown that firms and individual employees can benefit from mobility events (Rosenkopf & Almeida, 2003; Shipilov, Godart, & Clement, 2017). However, scholars have also demonstrated the effect that legal constraints can have on the likelihood that an individual is going to move (e.g., Marx, 2011). For example, non-compete agreements and the reputation for litigation toughness may present a constraint on employees leaving their current firms (Ganco, Ziedonis, & Agarwal, 2015). Future research could study the extent to which signaling can help new venture to deal with these constraints to move.

Furthermore, future research can contribute to the literature by studying the outcomes of these hiring events. In this study, we propose that new ventures can attract inventors through signaling. Our arguments revolve around knowledge-based motives that new

ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

ventures have when hiring inventors. We believe that it is also important to understand whether the hiring events help ventures to acquire and re-combine knowledge in productive ways (Tzabbar, 2009; Tzabbar and Kehoe, 2014; Kehoe and Tzabbar, 2015). Furthermore, our focus on high-tech entrepreneurial ventures suggests other topics that might be examines, such as whether it is more valuable for new ventures to hire experienced inventors or inventors that are joining the labor market for the first time? Answers to these questions can contribute to our understanding of how mobility shapes the value creation and appropriation for entrepreneurial and innovative ventures.

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ATTRACTING KNOWLEDGE WORKERS TO HIGH-TECH VENTURES

APPENDIX A1

Table 1. Descriptive Statistics

	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9	10	11
1 Mobility	0.16	0.64	1.00										
2 VC prominence	0.02	0.07	0.16										
3 Alliance network prominence	0.20	0.31	0.06	0.20									
4 Number of investment rounds	2.77	1.99	0.10	0.16	0.35								
5 Pipeline	0.94	2.77	0.24	0.18	0.08	0.09							
6 Citation-weighted patent stock	1.88	8.14	0.25	0.19	0.07	0.14	0.24						
7 Star presence	0.16	0.24	0.05	0.11	0.28	0.40	0.18	0.16					
8 Early stage VC fund	0.49	0.50	-0.02	-0.09	-0.16	-0.44	-0.04	-0.08	-0.31				
9 CEO age	40.95	14.60	0.03	0.06	0.02	-0.01	0.08	0.03	0.11	-0.02			
10 CEO industry experience	5.77	7.18	-0.01	0.06	0.04	-0.05	0.04	0.06	0.18	-0.12	0.40		
11 TMT size	4.78	3.36	-0.01	0.16	0.14	0.01	0.12	-0.06	0.23	-0.02	0.38	0.33	
12 Firm age	5.78	3.91	0.16	0.12	0.05	0.33	0.11	0.22	0.04	-0.32	-0.09	-0.08	-0.14
N = 1657.													

APPENDIX A2

Table 2. Negative Binomial Regressions on Inbound Mobility

Variables	(1)	(2)	(3)	(4)	(5)
VC prominence		0.800*** (0.274)	1.667*** (0.517)	0.712** (0.278)	1.511*** (0.526)
Alliance network prominence		7.394*** (2.180)	7.395*** (2.096)	12.784*** (3.720)	12.227*** (3.777)
VC prominence x Number of rounds			-0.232* (0.138)		-0.253* (0.145)
Alliance network prominence x Number of rounds				-1.435** (0.681)	-1.278* (0.663)
Number of investment rounds	0.151*** (0.054)	0.093* (0.050)	0.141** (0.059)	0.150*** (0.054)	0.186*** (0.059)
Pipeline	0.108*** (0.033)	0.066* (0.035)	0.074* (0.040)	0.058 (0.035)	0.066 (0.041)
Citation weighted patent stock	0.015 (0.010)	0.006 (0.010)	0.007 (0.009)	0.003 (0.010)	0.004 (0.009)
Star presence	0.370 (0.538)	0.243 (0.502)	0.181 (0.521)	0.314 (0.521)	0.241 (0.526)
Early stage VC fund	0.289 (0.267)	0.230 (0.251)	0.288 (0.249)	0.297 (0.250)	0.344 (0.247)
CEO age	0.014 (0.009)	0.013 (0.009)	0.014 (0.009)	0.013 (0.009)	0.013 (0.009)
CEO industry experience	-0.009 (0.016)	-0.021 (0.015)	-0.024 (0.016)	-0.024 (0.016)	-0.026* (0.016)
TMT size	0.013 (0.032)	0.013 (0.033)	0.004 (0.034)	0.018 (0.034)	0.009 (0.035)
Firm age	0.136*** (0.028)	0.119*** (0.026)	0.117*** (0.027)	0.121*** (0.026)	0.120*** (0.027)
Constant	-19.667** (2.446)	-23.799*** (2.101)	-23.091*** (2.356)	-34.616** (3.713)	-31.459*** (0.943)
Year fixed effects	Included	Included	Included	Included	Included
Industry subgroups	Included	Included	Included	Included	Included
N=1657. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses					

APPENDIX A3

Figure 1. Interaction Effects of VC Prominence and Number of Rounds on Inbound Mobility

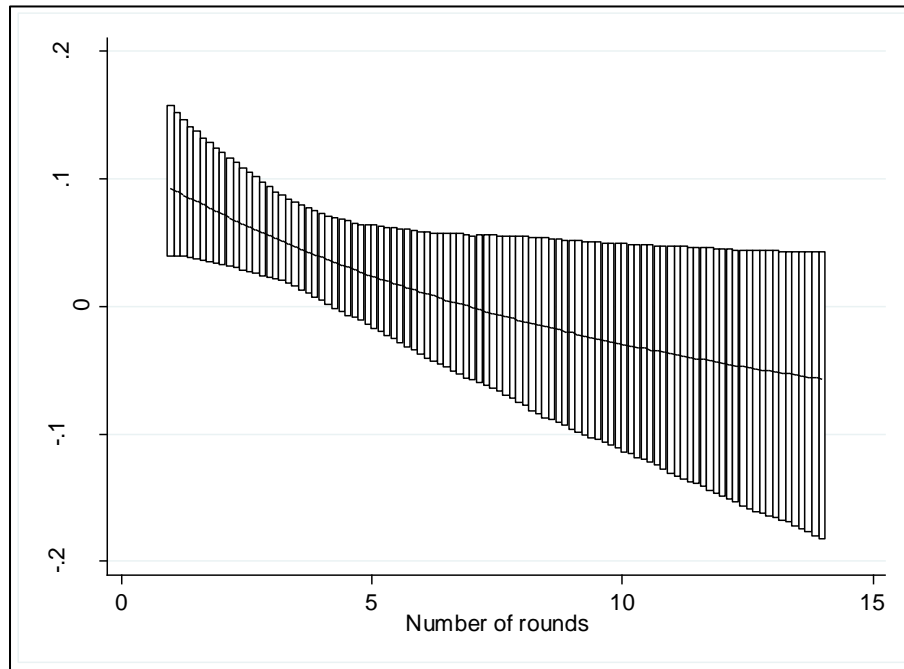


Figure 2. Interaction Effects of Alliance Network Prominence and Number of Rounds on Inbound Mobility

